WILDLIFE RESEARCH IN THE NORTH AMERICAN ARCTIC

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THE civilized world has always been interested in the animal life of its frontiers. This is no less true of the arctic frontiers of our civilization than it was for the hinterland of the Graeco-Roman world. In part the interest is commercial; the whalebone whales and the walrus were followed from civilized shores to their arctic home waters, and the merchants who had sought sea routes to the orient soon contented themselves with new sources of furs. The gyrfalcon was commercialized for falconry in the middle ages, and the Greenland gyrfalcon was specially prized. Its unavailability at the end of the fourteenth century is a witness to the decline of the Greenland colony. As the falcon trade preceded recorded exploration, so the fur trade preceded scientific investigation.

There has also been from the beginning an element of curiosity, which is the foundation of science. Early naturalists speculated on how animals lived in the Arctic, and explorers left a series of incidental notes, which modern investigators can find only by reading their whole narrative. Barents, for instance, the first explorer in the modern sense, wrote an account of the toxic effect of polar-bear liver which is a model of reporting and could preface any biochemical or physiological dissertation on the subject.

Although it is impossible to separate biological research into compartments a classification can be made with some historical and logical warrant, provided the overlap is not forgotten.

The faunal inventory

The first task of the scientist was an inventory of the arctic birds and mammals showing the different specific entities, their geographical variations, and their distribution in space and time. This task is far from complete, and continues now with the more detailed concept of the ecological inventory, in which distribution is expressed in terms of numbers, and habitat or environmental preference. The catalogue of species is just about complete; one may expect some animals now called species to be reduced to synonomy, but the chances of new entities being discovered are very limited. However, an undoubtedly new bird species was discovered in Florida in 1918 (Howell, 1919), six years after Chapman (1912) remarked that no new species had been found in eastern North America for twenty-five years. Although this discovery was hailed as a marvel, still another bird, apparently qualifying as

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a new species, was found twenty-eight years later (Haller, 1940), in the eastern United States. Either speciation still goes on, or species still hide out, or both.

A recognizable and acceptable stage will have been reached when reasonably complete series of arctic birds and mammals are available in institutional collections, so that those wishing to study any group can do so with little trouble, and monographs dealing with the larger regions are published. We are far from that goal now. In a broad sense, the inventory is interminable, for evolution, including such events as the invasion of great areas by the coloured fox (*Vulpes fulva*), may always intervene to prevent any inventory from coming to an end.

The scientific study of wild animals became established on an organized basis about the same time that mapping of the Arctic began to be worked out systematically, and settlements were made in Greenland and Hudson Bay. Zoologists both solicited collections and sent out collectors; and in the course of time they themselves were able to go on organized expeditions.

Through members of the Royal Society who came into contact with patrons standing high in the councils of the Hudson's Bay Company, officers of the company sent home splendid collections. Their contribution is described by Baillie (1946). Alexander Light, James Isham, Andrew Graham, and Humphrey Marten may be mentioned as officers who became scientific collectors. Thomas Hutchins was a scientist who became an officer of the company. Samuel Hearne was an officer who attained recognition from scientists. It is nowhere indicated that the company suffered through this digression from fur trading. At a later date the same technique was used by the Smithsonian Institution to get collections from the Mackenzie area. The lamentably brief pioneer field collection efforts of Robert Kennicott (Chic. Acad. Sci., 1869) aroused the interest of seasoned company traders and the contact thus made was continued by Spencer F. Baird. Tradition has it that the Smithsonian sent barrels of rum, in which specimens were to be pickled, and received from the grateful traders, not pickled animals, but well prepared specimens of birds and mammals. One of these traders, Roderick MacFarlane, published important original reports.

The more important scientific exploring expeditions made natural history collections, and took scientists into the Arctic. Preble (1902, 1908) and Osgood and Bishop (1900), who made field collections for the U.S. Bureau of Biological Survey, also performed the very important service of listing and compiling the contributions of all their predecessors. Since that time there have been additional compilations on the fauna of arctic Canada (cf., Anderson and Taverner *in* Bethune, 1934). Many references may be found in a paper by the writer (Clarke, 1940).

It hardly seems right to dismiss the pioneer zoological collectors of the American Arctic with a summary reference to the compilations where their works are listed. Many of them were scientific adventurers in the highest sense, working with a minimum of outside aid and financial support and yet doing work which would have been a credit to the most luxuriously equipped

parties. One thinks especially of Kumlien in Baffin Island, of Hantzsch who perished in west Baffin Island, of Frank Russell in the Mackenzie area, and of the first Stefansson–Anderson party on which R. M. Anderson did the zoological work. These are merely outstanding examples.

A remarkably complete list of Greenland mammals was given in "Kongespejlet" (King's Mirror) written in the thirteenth century ('Grønl. Hist. Mindesm.' Vol. 3, pp. 326–9), which also includes Ivar Baardson's (pp. 248–64) account of the game in Eystri Bygd, and even the earlier sagas had enumerated the principal birds and mammals ('Grønl. Hist. Mindesm.' Vol. 1, p. 205). The missionary, Hans Egede, may be said to have recommenced the process, and O. Fabricius's monumental 'Fauna Groenlandica' (1780) antedated any comparable work covering other areas with which we are concerned. We now have monographs on mammals and birds by Winge (1898, 1902) and still later on birds by Salomonsen (1950–1). In addition, the Fifth Thule expedition extended Greenland investigations to Canada, and made some contributions to the inventory of its fauna.

The Russian occupation of Alaska began with a faunal report by Steller, to which the ensuing years of Russian occupation added little. On the other hand the zoological work of Kennicott antedated the United States' purchase, and was merely the forerunner of a long series of faunal investigations by both public and private institutions. Recent work by the Arctic Health Research Center at Anchorage has just about completed the inventory on mammals of arctic Alaska (Rausch, 1953). Bailey's 'Birds of arctic Alaska' (1948), however, was written before many collectors had penetrated interior areas such as the Brooks Range and may need additions.

Unfortunately the bird and mammal section of the 'Report of the Canadian Arctic expedition, 1913–18', was never published. The collections have long been available at the National Museum of Canada, and have been used in the preparation of many publications. The same cannot be said of the Ungava Peninsula collections accumulated during fifty years by the Carnegie Museum at Pittsburgh, under the leadership of W. E. Clyde Todd. There has been no preliminary publication and a complete work has yet to appear. Some valuable notes on mammals, and a few studies of birds have appeared, but the bird collection is not yet available *in toto* to other workers.

For those whose interest is primarily in the faunal inventory, Alaska and Greenland offer little new ground for field work. At the present stage collecting is best repaid in little known areas of Canada. It must, however, be admitted, that the bulk of Greenland collections are in Denmark, and larger Greenland collections in North American institutions would be welcomed.

In Canada there are only five good basic collections from the whole of the Yukon Territory, these being from the arctic coast, the former Canol Road, and the Alaska Highway. In the Northwest Territories it would be possible to describe the ranges of birds species well, and of mammal species fairly well. There are good collections from the whole arctic coastal zone east to Coronation Gulf, and from the Mackenzie delta, the Great Bear Lake area, Wood Buffalo National Park, Southampton Island, and Baffin Island.

Parts of Ellesmere, Melville, Devon, Banks, and Victoria islands are represented in collections, and collections have been made at all of the newer meteorological stations.

Virgin collecting territory on the arctic mainland of Canada west of Hudson Bay, is only a few miles from the coastal and inland settlements on navigable waters, and from the shores of the navigable waters themselves. Incidental collecting done in the past by exploring or administrative parties, affects the usefulness only of similar efforts, and not of really systematic collecting. Exceptions to this are all areas south of Great Slave Lake, and two areas to the north: the Anderson River where MacFarlane made a thorough collection ninety years ago, though it does not survive in such a state that it could not well be repeated, and the Nueltin Lake area, recently surveyed by Harper (1949). It is doubtful if there are as many specimens available from Yellowknife, the principal settlement in the territories today, as the early Hudson's Bay men, and Preble after them, collected at the old and new sites of Fort Rae. Such interesting areas as, for example, several mountain regions both on the east and west sides of the middle Mackenzie River, are unrepresented or poorly represented in collections, so also are Wager Bay, Bathurst Inlet, the Peel River above Fort McPherson, and the mountains west of Aklavik. Again, there are large areas around Contwoyto Lake, and the Back, Thelon, and Dubawnt rivers without any really useful collection.

In the arctic islands points of zoological interest still remain to be cleared up on Baffin Island, although more collecting has been done there than elsewhere. Prince of Wales, Bathurst, and Borden islands, and the north part of Victoria Island are areas of obvious interest, in the light of available information on their geology and topography. The possibility of linking up what is already known about Baffin Island and the western mainland coast with the many unknowns to form a solid body of knowledge, is still out of sight.

Life history studies

The study of the lives of arctic birds and mammals on a systematic basis is just beginning. Fragmentary data that have resulted from reconnaissance trips and collections show that each species has peculiarities that can be related to the arctic environment. Studies of lemmings, ground squirrels, and a whole series of arctic birds are well advanced in Alaska. Hanson and Smith's (1950) completed study of Canada Geese extends from the Arctic to the southern states. An equivalent study of the Golden Plover might extend from Alaska to Patagonia. Tinbergen's monograph (1939) of the behaviour of the snow bunting is a noteworthy example of what can be done in the Arctic.

The dramatic searches for the nesting grounds of the Blue Goose (Soper, 1930), Ross's Goose (Cartwright and Gavin, 1940), and Bristle-thighed Curlew (Kyllingstad, 1948), are reminders of the incompleteness of arctic knowledge. Equally important information remains to be learned about most arctic species. Tinbergen's work on the snow bunting is the barest beginning in the study of the behaviour of arctic birds. It is in the great breeding colonies of the north that the studies by Heinroth and Lorenz on the behaviour of geese and ducks

could be followed up most profitably. Sea-bird colonies offer unrivalled opportunities for behaviour studies and even the passerine Lapland Longspurs live closer to each other than the passerine birds to the south.

For the mammals we have Murie's (1944) wolf behaviour studies, but little else. Nothing has been done on the foxes: for instance what is behind the expansion of the coloured fox, and how does this affect the arctic fox? It is surprising that the life history of such a social animal as the caribou has not been the subject of special studies, though many workers have dealt with the species in a general way, and have made comments on practically every phase of its life history, working from a basic interest in numbers (cf., Banfield, 1951). The social behaviour of the muskox would also make a worthwhile study. The volume of general information that can exist without any full knowledge of the animals concerned is illustrated by Dutilly's (1949) 'Bibliography of reindeer, caribou, and musk-ox', which lists 2,422 titles. The larger bears must be studied soon or the opportunity may be lost, and among the birds, the least hint about Whooping Cranes[1] and Eskimo Curlews should be followed up immediately.

Animal populations

It has already been noted that the modern conception of an inventory of animals involves numbers and local distribution. Numbers are dynamic and fluctuate in both time and space. Populations of various species are interdependent. The arctic winter, itself severe, restricts the resources available so that animals must leave, like most birds, or adapt themselves. One of the most characteristic features of arctic animal populations is the great variation in numbers from year to year.

The question of periodic fluctuations in numbers of northern animals was perhaps the first matter beyond the cataloguing of the fauna to receive attention. Bernard Ross of the Hudson's Bay Company drew attention to it (Coues, 1877) and so did his contemporary, Roderick MacFarlane, whose comments were published at a much later date. Seton (1911) made the first clear statement of the problem. It was left to Charles Elton's Bureau of Animal Population (Chitty, 1950; Elton, 1942) to initiate and carry out detailed studies. The records of the fur trade were used as a statistical base, and year-by-year records were obtained from residents in the Arctic. We now have a substantial outline of the population cycles of arctic mammals and birds. Most of the details are lacking and can only be filled in by field work in the north, and especially by large-scale marking of individual animals. No other biological problem is more important or more challenging.

Animal disease and parasites

The *Parliamentary Papers* of Franklin Search days contain a dissertation on "Eskimo dog disease" (Ninnis, 1878), which is still a serious problem in the

[1]Since this account was written the nesting grounds of the Whooping Crane have been found in Wood Buffalo National Park.

north. This disease, or at least one of its forms, has now been identified as rabies (Plummer, 1947 a,b). Animals suffering from "dog disease" have been found to have typical Negri bodies in the brain, but there appear to be significant peculiarities that await study. Further investigation will become easier as laboratory facilities expand. At the moment it is still not known how many epidemic dog-wolf diseases there are in the Arctic, though certainly there are more than one.

It has already been shown that the Arctic may be a proving ground for the study of human immunity to disease. Already attention has been drawn to poliomyelitis, as records have become available of the progress of epidemics. The possibility that wild animals play a part in spreading some diseases becomes more apparent in sparsely settled areas. A recent disastrous beaver epidemic in Ontario was found to be due to tularemia of a type in which initial cultures are difficult to make (Labzoffsky and Sprent, 1952). A coincident blood testing of local Indians showed a number of persons with high titres, but there was no history of sickness.

Obviously the diseases of wild birds and mammals require more general study. The human link may be unsuspected, or indirect. The epidemiology of any disease casts light on human disease, and information about diseases of wildlife suggests new ideas to the medical profession. Also, diseases may be very important in the natural fluctuations of wildlife species. Some wildlife diseases which have not been studied in the American Arctic, like the virus diseases of colonial sea birds, may demand attention. Others now unsuspected may be more important.

Parasites are of major importance in the life of arctic species. Not unnaturally, those that might affect man have been the first to be studied. Trichinosis has long been known (Connell, 1949), but it was the dramatic account of its effect on a German task force that principally directed attention to it. It is being actively studied by the various health units, and may be expected to reward investigators for a long time to come.

Another parasite of potential importance is the tapeworm which causes hydatid disease. It is present as an adult in dogs and wolves throughout the north, and the cysts are to be found in ungulate game and domestic reindeer, with serious consequences to the health of these animals. In some subarctic regions of the Old World the disease is important to man. There are serious infections in North America, but admittedly the incidence is very low in view of the obvious possibility of universal infection. The complexity of the problem, the extent of the present studies, and the large field for future investigation is apparent from the writings of Rausch (1952), Sweatman (1952), and Miller (1953).

Physiology of birds and mammals

The recent availability of laboratory facilities has made possible the study of certain physiological problems which are linked with life in the Arctic. The principal questions are concerned with insulation from cold and fat

metabolism. Obviously these have a significant bearing on human accommodation, and in this respect the Eskimo has been rightly considered, in the metabolic and psychological sense, as a well-adjusted arctic race (*see* Krogh and Krogh, 1913). Reference may be made to a paper by Musacchia and Wilber (1952) on the arctic ground squirrel, which shows what is now done with good laboratory facilities, and to work discussed by Irving at the 1951 Alaskan Science Conference (1951) on the resistance to cold of the extremities of animals, including tiny birds. He showed that interesting comparisons of the fat properties and the insulation of tissues in tropical and arctic species had also been made. More recently, Irving (1953) has given a still further report on his work.

Barents' experience with polar-bear liver has been repeated many times. Rodahl's study (1949 a,b,c, 1950) of arctic vitamin sources and the discovery that the liver was so rich in vitamin A that it was toxic was made in east Greenland.

Administration

It is unfortunate that North American biologists have taken so little advantage of the facilities of the Danish Arctic Research Station at Godhavn. Established in 1906, it has always been prepared to accommodate research workers in all fields of biology. It has not much modern laboratory equipment, but it is always reasonably well supplied and has a magnificent library. There are many problems that could well be studied there.

The Canadian Government may be said to have first extended its work north when, in 1884 (Gordon, 1885), it chartered the steamship *Neptune* to take a scientific party to Eastern Arctic waters. Similar expeditions were made at intervals thereafter and have been made annually since 1922. The principal purpose has been to resupply government establishments, but in many instances scientists have been invited to make the trip, with valuable and stimulating results to arctic research. In 1950 a new government ship, the *C. D. Howe*, was commissioned, and remains the carrier of the official Eastern Arctic Patrol, though a variety of transport is now available to scientists. Air service to the Eastern Arctic did not start until late in the Second World War, but aircraft have been used for transporting zoologists in western areas since about 1930 and from about 1937 most have reached their main base by this means.

Land explorations moved north in 1887–8 when a survey under H. Dawson, of the Geological and Natural History Survey, and W. Ogilvie, of the Topographical Surveys Branch (Dennis, 1892), worked in the Yukon and Mackenzie regions. Collections and notes of vertebrate animals were made. The progress of government surveys has been continuous since that year. The Canadian Wildlife Service now functions as a fact-finding agency in the Canadian Arctic, with officers stationed at Fort Smith, Yellowknife, Aklavik, and Churchill. This is a most valuable development, because active research is now carried out on most of the economically important species. Such an agency, however, is not designed to handle many fundamental research

problems and should be able to look to others for certain types of basic information. Within its proper field it is already producing a series of useful reports which will amount to a formidable contribution to knowledge in the course of time.

Wildlife investigations and management in Alaska have been the function of the U.S. Fish and Wildlife Service, formerly the Bureau of Biological Survey, which sponsored Osgood and Bishop and subsequent workers. In recent years the service has carried out active management with members of its staff stationed in Alaska.

All efforts at wildlife research in the Arctic by persons based outside come to a stop whenever experimental work is needed. This stage requires facilities for year-round residence and a fully equipped laboratory plant. It is the laboratory that is the critical factor, because living quarters are generally available. The first properly equipped laboratory to be set up in the Arctic since the Danish station in 1906 was the Arctic Research Laboratory at Point Barrow, Alaska, established in 1947 under the auspices of the U.S. Office of Naval Research. It is the first, and still the only, laboratory in the North America Arctic available for the study of the biology of arctic animals on a broad basis. The first studies carried out were those of Irving and the Swarthmore group on metabolism of arctic animals; other studies on terrestrial vertebrates are listed by Shelesnyak (1948) and in *Arctic* (1952, 1953).

The University of Alaska, at College, near Fairbanks, was at first designed to stimulate training in mining engineering. It was not until early 1950 that research in vertebrate zoology started. The stimulus in this case was the establishment of the Alaska Cooperative Wildlife Research Unit at the University under Neil M. Hosley. In such units, of which there are a number in continental United States, the U.S. Fish and Wildlife Service supplies a leader and a coordinated program while the State, the University, and a private foundation, the Wildlife Management Institute, supply space, equipment, facilities, and funds. Dr. Hosley had not been long at College when he became dean, and he was then succeeded as unit leader by John Buckley. Under their leadership, and that of Brina Kessel, of the University, important studies of birds and mammals have been carried out.

The Arctic Health Research Center at Anchorage is likewise not primarily concerned with feral vertebrates, but the possible importance of other animals in human health and the general interest of arctic animals has been recognized in research by Robert Rausch and other members of the staff. The same could be said of the Arctic Aeromedical Laboratory at Ladd Field, where the staff have an intense interest in the physiology of arctic animals.

In Canada there is only one laboratory equipped for biological work, that of the Defence Research Board at Fort Churchill. As at Ladd Field and Anchorage, much of the research is carried out by staff members, but the facilities have frequently been used to assist other workers. Within the biological field the emphasis has been on invertebrate animals, but this is not inherent in the nature of the laboratory. The lack of laboratory facilities in the north is a major impediment to arctic wildlife research. Preferably, such

a laboratory should be a place where, in addition to its own research, facilities are provided at low rates for those who wish to work out their own problems.

It is impressive how many of the *ad hoc* problems in wildlife research, discussed in the Arctic Institute's *Bulletin* No. 1 (1946), have already been studied. Through its research program the Institute itself has sponsored about forty projects related to wildlife. The more basic ventures, such as the experimental study of population fluctuations once proposed by Elton, remain unattempted.

The completion of the faunal inventory, and the experimental study of animal fluctuations have been mentioned as requiring urgent attention. It would be tedious to list in detail the problems that could be studied in such a wide subject. Some have a high degree of urgency. The impact of commercial exploitation has already made itself felt on the game and fur-bearing species, and until their biology is adequately known it will not be possible to manage them intelligently. The productivity of the Arctic is low, a fact that is often masked by large aggregations of individuals, and wildlife resources may easily be depleted. They can make their proper contribution to the economy of the land only under scientific management. At least until a proper basis of management is found, the only safe practice is to keep large areas preserved from exploitation. Some large preserves may be needed for demonstration and research. They should be set aside now before ill-advised and disorderly exploitation makes it impossible.

Finally, there is a great need for publications. Much of the recent research cannot be properly discussed because it remains unpublished. It may be expressed as a principle that for every grant of funds for research there should be a corresponding provision for publication.

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